SPRINGTAILS (COLLEMBOLA) AS BIOINDICATORS OF SOIL POLLUTION

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НОГОХВОСТКИ (COLLEMBOLA) КАК БИОИНДИКАТОРЫ ЗАГРЯЗНЕНИЯ ПОЧВЫ

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Springtails represent a group of soil microarthropods with an exclusively wide distribution, high abundance and species diversity. Therefore, springtails are frequently used in bioindication studies of the impact of various anthropogenic factors on soil.

Collembola are used for bioindication in soils polluted by highway traffic; atmospheric exausts from cement factory; pig slurry.

Highway traffic exhausts include a complex of pollutants: 1) motor vehicle pollution (heavy metals); 2) products of friction between automobile parts and highway cover (mainly iron, calcium, magnesium etc.); 3) salts (mainly natrium chloride) which are used in winter to remove glassy ice from the highway.

The main component of cement factory discharges into the atmosphere is dust formed in rotary kilns and occasionally, where electrostatic precipitators fail to manage the flow of dust, lots of it is discharged into the atmosphere. The dust contains mainly compounds of calcium as well as other metals (magnesium, strontium, manganese etc.).

Pig slurry is a highly diluted liquid (only about 3 per cent of solid sediment), rich in organics and ammonium.

Investigations of roadside pollution impact on Collembola were carried out on the largest highways. Sampling plots were chosen at places with the most even microrelief and plant cover (perrennial grasses, Pinetum hylocomiosum). Samples were taken on transects perpendicular to the highway. Correlations between the numbers of Collembola and chemical element content in soil were calculated.

Correlations between the numbers of collembolans and the levels of heavy metals were not significant. Some species (Friesea mirabilis (Tullb.), Folsomia fimetaria (L.), Lepidocyrtus lignorum (Fabr.)) were positively correlated with iron content in the soil. In some species abundance species (Pseudosinella alba (Pack.), Onychiurus armatus (Tullb.)) positively correlated with soil calcium level and pH. They are rather unstable and subjected to variation. It seems that these correlations most probably should be regarded as indirect ones, resultant from actual relations between the complexes of physical and chemical as well as biological factors.

The impact of soil pollution with cement dust on Collembola was studied in a Betuletum oxalidosum at various distances from cement factory. This kind of pollution can be regarded as a flow of nutrients into the ecosystem. A moderate flow of nutrients first leads to eutrophication of the system, but later destroys the system. In case of moderate pollution, collembolans had slightly higher species diversity (H') than under heavy pollution or in controls. Increase in H' is a result of complicated changes in community structure, but the governing tendency in these changes is a depression of epigeial springtails and hypertrophy of eudaphic ones. Three main patterns of population density distribution for indicator species: 1) increase of density under the increase of pollution (Megalothorax minimus (Will.)); 2) decrease in density under augmented pollution (Lepidocyrtus lignorum, Tomocerus flavescens (Tullb.), Sminthurus fuscus (L.), Dicyrtomina minuta (O.Fabr.), Dicyrtoma fusca (Lucas), Isotoma notabilis Schäff., Willemia anopthalma Börn., Isotomiella minor (Schäff.), Sminthurinus aureus (Lubb.)); 3) increase in density under moderate or low pollution (Arrhopalites spp., Pseudachorutes spp., O. armatus, Willemia aspinata Stach). Soil pollution with cement dust affects the whole complex of ecological factors important for collembolans - soil structure and pH, water containing capacity, food supply, litter decomposition.

A moderate flow of pig slurry to the ecosystem also leads to it eutrophication. Peculiarity of this kind of pollution is its irregular pattern as determined by accidental situations in slurry processing.

Dominant species inhabiting the solid fraction of slurry on the surface of sedimentation pools are the compost species Proisotoma minuta (Tullb.), Hypogastrura manubrialis (Tullb.) and Lepidocyrtus cyaneus Tullb. I.notabilis joined at later stages of decomposition. The first three of the above-mentioned species were rare in areas (meadows) polluted by pig slurry. In meadows where an accidental overflow of pig slurry has been taking place, hemiedaphic species I.notabilis and Cryptopygus bipunctatus (Axelson) dominated, both making up to 80 per cent of all Collembola. The structure of the collembolan complex in a polluted Picetum oxalidosum is very similar to that of the control. I.notabilis was dominant on both plots. As recedents on the polluted plot there were P.minuta and Neelus minutus Folsom. In this case, the former can be regarded as pollution indicator. N.minutus is a rare species in our collection of collembolans from the Republic, and that many individuals of this species were found by us for the first time. Presumably, it is also a bioindicator.

Therefore in case of soil pollution with pig slurry the complex of bioindicators differs from that characterizing the succession of decomposition process of slurry solid fraction. It seems that only in the presence of that fraction a complex of ecological factors is formed essential for the existence of compost species.

Our studies have shown that springtails, in general, can be used as bioindicators of soil pollution.

Different requirements of various species to environmental conditions cause diversity of their reaction to soil pollution. The structure of springtail community reflects changes of a vast range of soil ecological factors, and hence is a valuable bioindicator of changes in soil ecosystems.

References

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D i s c u s s i o n

Kuznetzova N.A.: Какие параметры структуры сообщества коллембол наиболее чувствительны к загрязнению?

Melecis V.P.: Различные параметры структуры сообщества предполагают различные аспекты изучения этого сообщества. Поэтому для целей биоиндикации не только возможно, но даже следует использовать комплекс этих параметров для более полного описания изменений структуры сообщества.